1. **What is Micro Service?**

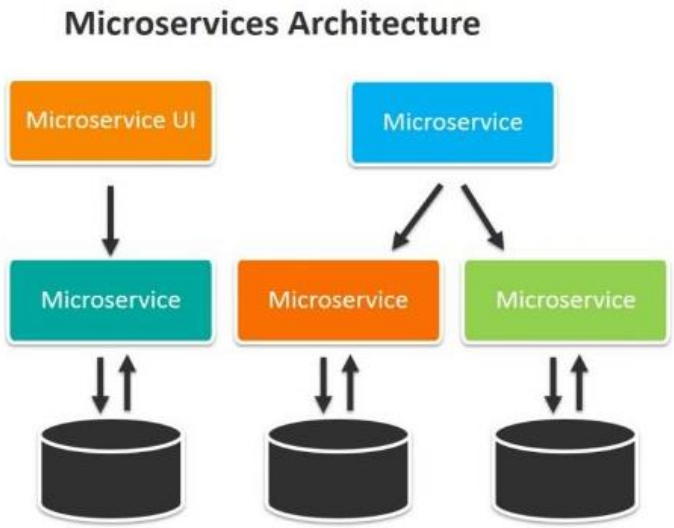
   Microservices are the small services that work together.
   Microservices are small and independent units and runs on its own process and database.

2. **Explain the Micro Services Architecture?**

   Microservice architecture, aka micro services, are a specific method of designing software systems to structure a single application as a collection of loosely coupled services.

   Each component of a microservice architecture has,

   - ✓ Its own CPU
   - ✓ Its own runtime environment
   - ✓ Often, a dedicated team working on it, ensuring each service is distinct from one another

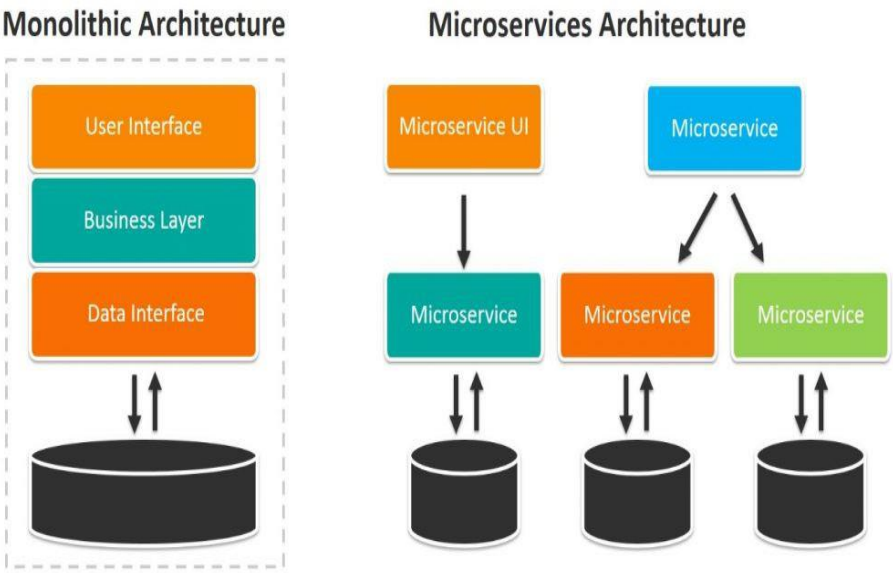


3. **Differentiate monolith and Micro Services architecture?**

The monolithic architecture pattern has been the architectural style used in the past. In a monolithic architecture, the software is a single application distributed on a CD-ROM, released once a year with the newest updates. Examples are Photoshop. Monolithic structures make changes to the application extremely slow. Modifying just a small section of code can require a completely rebuilt and deployed version of software.

Each component of a microservice architecture has,

- ✓ Its own CPU
- ✓ Its own runtime environment
- ✓ Often, a dedicated team working on it, ensuring each service is distinct from one another



4. Difference between Monolith application and Micro Service?

Monolith	**Micro Services**
Monolithic architecture is built as one large system and is usually one code-base	Microservices architecture is built as small independent module based on business functionality
It is not easy to scale based on demand	It is easy to scale based on demand.
It has shared database	Each project and module has their own database
Large code base makes IDE slow and build time gets increase.	Each project is independent and small in size. So overall build and development time gets decrease.
It extremely difficult to change technology or language or framework because everything is tightly coupled and depend on each other	Easy to change technology or framework because every module and project is independent
You must redeploy the entire application on each update.	Specific Micro Service to be deployed
If any of the module failed total application modules functionality can failed	If any of the module failed it won't impact others.
Development time is high	Development time is less

5. **Difference between SOA and Micro Service?**

SOA	Micro Services
Designed to share resources across services	Designed to host services which can function independently
Frequently involves component sharing	Typically does not involve component sharing
Involves sharing data storage between services	Each service can have an independent data storage
Better for large scale integrations	Better for smaller and web-based applications
Less flexibility in deployment	Quick and easy deployment
SOA is focused on application service reusability	Microservices are more focused on decoupling.

6. **Explain the principles of Micro Services?**

- ✓ **Single Responsibility:** The single responsibility principle states that a class or a module in a program should have only one responsibility. Any microservice cannot serve more than one responsibility, at a time.
- ✓ **Modeled around business domain:** Microservice never restrict itself from accepting appropriate technology stack or database. The stack or database is most suitable for solving the business purpose.
- ✓ **Isolated Failure:** The large application can remain mostly unaffected by the failure of a single module. It is possible that a service can fail at any time. So, it is important to detect failure quickly, if possible, automatically restore failure.
- ✓ **Infrastructure Automation:** The infrastructure automation is the process of scripting environments. With the help of scripting environment, we can apply the same configuration to a single node or thousands of nodes. It is also known as configuration management, scripted infrastructures, and system configuration management.
- ✓ **Deploy independently:** Microservices are platform agnostic. It means we can design and deploy them independently without affecting the other services.

7. **Explain advantages and disadvantages of Micro Services?**

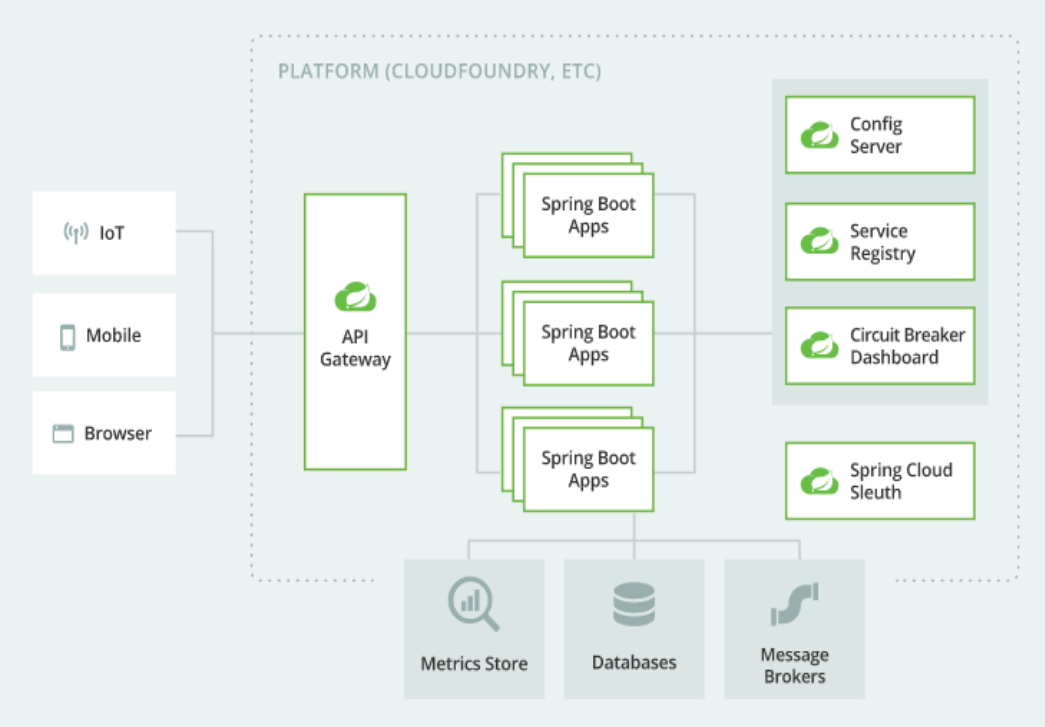
Advantages of Microservices:

- ✓ Microservices are self-contained, independent deployment module.
- ✓ Microservices are independently manageable services. It can enable more and more services as the need arises. It minimizes the impact on existing service.
- ✓ It is possible to change or upgrade each service individually rather than upgrading in the entire application.
- ✓ Faster release cycle.
- ✓ Dynamic Scaling
- ✓ Less dependency and easy to test.

Disadvantages of Microservices

- ✓ There is a higher chance of failure during communication between different services.
- ✓ Difficult to manage a large number of services.
- ✓ The developer needs to solve the problem, such as network latency and load balancing.
- ✓ Complex testing over a distributed environment.

8. Explain the Components of MicroServices?



Spring Cloud Config Server: Responsible for maintaining the properties/yml files specific to all services. With the help of this we can remove the duplicate properties among services. Its resolve the problem of profile specific files also. We can enable the Spring Cloud Config Server by using the annotation **@EnableConfigServer**.

Netflix Eureka Naming Server: Eureka naming server is an application that holds information about all client service applications. Each microservice registers itself with the Eureka naming server. The naming server registers the client services with their port numbers and IP addresses.

This server will run on default port number 8761.

Eureka naming server fills the gap between the client and the middle tier load balancer.

For Example we already have two instances of CurrencyExchangeService1 and CurrencyExchangeService2 running on 8000, 8001

Suppose that we want to start another instance of currency-exchange-service that is CurrencyExchangeService3 and launch it on port 8002. Here a question arises, will ribbon be able to distribute the load to it?

The Eureka naming server comes into existence when we want to make maintenance easier. All the instances of all microservices will be register with the Eureka naming server. Whenever a new instance of a microservice comes up, it would register itself with the Eureka naming server. The registration of microservice with the naming server is called Service Registration.

Whenever a service wants to talk with another service, suppose CurrencyCalculationService wants to talk to the CurrencyExchangeService. The CurrencyCalculationService first talk with the Eureka naming server. The naming server provides the instances of CurrencyExchangeService that are currently running. The process of providing instances to other services is called Service Discovery.

Service registration and service discovery are the two important features of the naming server.

Hystrix Server: Hystrix server acts as a fault-tolerance robust system. It is used to avoid complete failure of an application. It does this by using the Circuit Breaker mechanism. If the application is running without any issue, the circuit remains closed. If there is an error encountered in the application, the Hystrix Server opens the circuit. The Hystrix server stops the further request to calling service. It provides a highly robust system.

Consider a scenario in which six microservices are communicating with each other. The microservice-5 becomes down at some point, and all the other microservices are directly or indirectly depend on it, so all other services also go down.

The solution to this problem is to use a fallback in case of failure of a microservice. This aspect of a microservice is called fault tolerance.

Fault tolerance can be achieved with the help of a circuit breaker. It is a pattern that wraps requests to external services and detects when they fail. If a failure is detected, the circuit breaker opens. All the subsequent requests immediately return an error instead of making requests to the unhealthy service. It monitors and detects the service which is down and misbehaves with other services. It rejects calls until it becomes healthy again.

Netflix Zuul API Gateway Server: Zuul Server is an API Gateway application. It handles all the requests and performs the dynamic routing of microservice applications. It works as a front door for all the requests. It is also known as Edge Server.

Zuul is built to enable dynamic routing, monitoring, resiliency, and security.

Zuul provides a range of different types of filters that allows us to quickly and nimbly apply functionality to our edge service.

Authentication and Security: It provides authentication requirements for each resource.
Insights and Monitoring: It tracks meaningful data and statistics that give us an accurate view of production.
Dynamic Routing: It dynamically routes the requests to different backed clusters as needed.
Stress Testing: It increases the traffic to a cluster in order to test performance.
Load Shedding: It allocates capacity for each type of request and drops a request that goes over the limit.
Static Response Handling: It builds some responses directly at the edge instead of forwarding them to an internal cluster.

Netflix Ribbon: It provides the client-side balancing algorithm. It uses a Round Robin Load Balancing.

Zipkin Distributed Server: Zipkin is an open-source project m project. That provides a mechanism for sending, receiving, and visualization traces.

Seluth: Responsible to maintain the unique id from request start to completion.

The Spring Cloud Sleuth token has the following components:

Application name: The name of the application that is defined in the properties file.
Trace Id: The Sleuth adds the Trace Id. It remains the same in all services for a given request.
Span Id: The Sleuth also adds the Span Id. It remains the same in a unit of work but different for different services for a given request.

9. **How to setup the Spring Cloud Config Server give an example?**

- ✓ Add below dependency in pom.xml,

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-config-server</artifactId>
</dependency>
```

- ✓ Add the below annotation on main class of the Spring Boot application

```
@SpringBootApplication
@EnableConfigServer
public class InternetBankingCloudConfigServerApplication {

    public static void main(String[] args) {
        SpringApplication.run(InternetBankingCloudConfigServerApplication.class, args);
    }

}
```

- ✓ Add the below things in application.yml file get the properties/yml files from github

```yaml
spring:
  application:
    name: internet-banking-cloud-config-server
  cloud:
    config:
      server:
        git:
          uri: https://github.com/full-stack-org/internet-banking-full-stack-react-micro-services/tree/main/internet-banking-git-config-files

server:
  port: 8888
```

- ✓ Default port for the Spring Cloud Config Server is 8888

10. Explain about Cloud Config Client and given example to get the details from Config Server?

Cloud Config Client is responsible for reading the details from Cloud Config Server

- ✓ Add below dependency in pom.xml file of micro services

```xml
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-config</artifactId>
</dependency>
```

- ✓ Add the below bootstrap.yml file to get the properties file or content from Config server

bootstrap.yml

```yaml
spring:
  cloud:
    config:
      uri:
      - http://localhost:8888
```

11. Give an example for Netflix Eureka Server configuration?

- ✓ Add below dependency in pom.xml file of Eureka server micro service

```xml
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-netflix-eureka-server</artifactId>
</dependency>
```

- ✓ Add the below annotation on main class of the Spring Boot application

```java
@SpringBootApplication
@EnableEurekaServer
public class InternetBankingEurekaServerApplication {

    public static void main(String[] args) {
        SpringApplication.run(InternetBankingEurekaServerApplication.class, args);
    }

}
```

- ✓ Add the below things in application.yml file to note it as Eureka Server

```yaml
spring:
  application:
    name: internet-banking-eureka-server

server:
  port: 8761

eureka:
  client:
    fetch-registry: false
    register-with-eureka: false
```

- ✓ Default port of Eureka Server is 8761

12. Give an example for Eureka Client?

- ✓ Add below dependency in pom.xml file of micro service

```xml
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-netflix-eureka-client</artifactId>
</dependency>
```

- ✓ Add the below annotation on main class of the Spring Boot application

```java
@SpringBootApplication
@EnableEurekaClient
public class InternetBankingExternalAccountsApplication {

    public static void main(String[] args) {
        SpringApplication.run(InternetBankingExternalAccountsApplication.class, args);
    }

}
```

- ✓ Add the below things in application.yml file to note it as Eureka client

```
eureka:
  client:
    fetch-registry: true
    serviceUrl:
      defaultZone: http://localhost:8761/eureka
```

13. Given an example for Netflix ZuulApiGateway?

- ✓ Add below dependency in pom.xml file of ZuulApiGateway micro service

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-netflix-zuul</artifactId>
</dependency>
```

- ✓ Add the below annotation on main class of the Spring Boot application

```
@SpringBootApplication
@EnableZuulProxy
public class InternetBankingZuulApiGateWayApplication {

    public static void main(String[] args) {
        SpringApplication.run(InternetBankingZuulApiGateWayApplication.class, args);
    }

}
```

- ✓ Add the below filter in micro service that should extend ZuulFilter

```
@Slf4j
@Component
public class ZuulApiGateWayFilter extends ZuulFilter {

    @Override
    public boolean shouldFilter() {
        return true;
    }

    @Override
    public Object run() throws ZuulException {
        HttpServletRequest httpServletRequest = RequestContext.getCurrentContext().getRequest();
        log.info("Request is -> {} , Request uri -> {}", httpServletRequest, httpServletRequest.getRequestURI());

        return null;
    }

    @Override
    public String filterType() {
        return "pre";
    }

    @Override
    public int filterOrder() {
        return 1;
    }

}
```

- ✓ Add the below properties to maintain the micro services timeouts

```yaml
spring:
  application:
    name: internet-banking-zuul-api-gate-way

server:
  port: 8765

zuul:
  host:
    connect-timeout-millis: 15000000
    socket-timeout-millis: 15000000
    connection-request-timeout-millis: 15000000

eureka:
  client:
    eureka-connection-idle-timeout-seconds: 40
    eureka-server-connect-timeout-seconds: 40
    eureka-server-read-timeout-seconds: 40

ribbon:
  eureka:
    enabled: true
  ReadTimeout: 9000000
  ConnectTimeout: 9000000

hystrix:
  command:
    default:
      execution:
        isolation:
          thread:
            timeoutInMilliseconds: 15000000
```

- ✓ We should register the ZuulApiGateway as Eureka client to check the registered micro services under Eureka Server.
- ✓ Default port for ZuulApiGateway is 8765

14. Give an example for Hystrix?

- ✓ Add below dependency in pom.xml file of micro service

```xml
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-netflix-hystrix</artifactId>
</dependency>
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-netflix-hystrix-dashboard</artifactId>
</dependency>
```

- ✓ Add the below annotations main class of the Spring Boot application

```java
@SpringBootApplication
@EnableHystrix
@EnableHystrixDashboard
public class AddingAllJarsApplication {

    public static void main(String[] args) {
        SpringApplication.run(AddingAllJarsApplication.class, args);
    }

}
```

- ✓ To handle the fallback of failure methods we need to add the below in controller code

```java
@HystrixCommand(groupKey = "boot app", commandKey = "boot app", fallbackMethod = "fallBackFailed")
@GetMapping("/getData")
public String getName() {
    String responseFromRestServicesApp = restTemplate.getForObject("http://localhost:8888/api/v1/sayHi",
            String.class);
    String responseFromReactFullStackApp = restTemplate.getForObject("http://localhost:9999/api/v1/getData",
            String.class);
    return responseFromRestServicesApp + "\n" + responseFromReactFullStackApp;
}

public String fallBackFailed() {
    return "Fall Back Failed";
}
```

- ✓ In the fallback method if it is string we should return the response as string. If it is object we should return the response as object response. For example if we are expecting the response as Student bean having fields as id, name in the fallback methods we should set the id and name data in fallback method and we should return that response.
- ✓ Hystrix Dashboard jar is used to track the error, success information of the applications. We need to get the details like http://localhost:9098/hystrix.stream

15. Give an example for micro services communication?

- ✓ Create two micro services

```
spring:
  application:
    name: internet-banking-account-opening-service

server:
  port: 8084
```

```
spring:
  application:
    name: internet-banking-forgot-password

server:
  port: 8082
```

- ✓ In the above example invoking the `internet-banking-account-opening-service` from `internet-banking-forgot-password`
- ✓ Add the below dependencies in pom.xml file

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-netflix-ribbon</artifactId>
</dependency>

<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-openfeign</artifactId>
</dependency>
```

- ✓ Add the below annotation on main class of the Spring Boot application

```
@SpringBootApplication
@EnableEurekaClient
@EnableFeignClients
public class InternetBankingForgotPasswordApplication {

    public static void main(String[] args) {
        SpringApplication.run(InternetBankingForgotPasswordApplication.class, args);
    }

}
```

- ✓ Add the below annotations in consumer class while invoking the provider service

```java
@FeignClient(name = "internet-banking-zuul-api-gate-way")
@RibbonClient(name = "internet-banking-account-opening-service")
public interface ForgotPasswordProxy {

    @PostMapping("/internet-banking-account-opening-service/internet/banking/password/v1/updatePassword")
    ForgotPasswordResponse updatePassword(@Valid @RequestBody ForgotPasswordRequest forgotPasswordRequest);

    @PostMapping("/internet-banking-account-opening-service/internet/banking/password/v1/findByCustomerId")
    FindByCustomerIdResponse getCustomeDataByCutomerId(@Valid @RequestBody FindByCustomerIdRequest findByCustomerIdRequest);

}
```

- ✓ As we are hitting the consumer service via ZuulApiGateWay we need to specify the **@FeignClient** name as ZuulApiGateWay application name
- ✓ As we are hitting the consumer `internet-banking-account-opening-service` we need to specify the **@RibbonClient** name as Consumer application name.
- ✓ In the **@PostMapping** we need to specify the url mapping as consumer name along with its controller path. Below is the consumer application controller,

```java
@RestController
@RequestMapping("/internet/banking/password/v1")
@Slf4j
public class UpdatePasswordController {
```

16. What is the use of Netflix Ribbon Client?

It provides the client-side balancing algorithm. It uses a Round Robin Load Balancing. It automatically interacts with Netflix Service Discovery (Eureka) because it is a member of the Netflix family. The important point is that when we use Feign, the Ribbon also applies.

17. Explain the features of Netflix Ribbon Client?

- ✓ Load balancing
- ✓ Fault tolerance
- ✓ Multiple protocols (HTTP, TCP, UDP) support in an asynchronous and reactive model

18. What is meant by load balancing and give different types of load balancing?

Load balancing is defined as the methodical and efficient distribution of network or application traffic across multiple servers in a server farm. Each load balancer sits between client devices and backend servers, receiving and then distributing incoming requests to any available server capable of fulfilling them.

There are two types of load balancing,

Server Side Load Balancing: Server side load balancing is a monolithic it applies between the client and the server. It accepts incoming network, application traffic, and distributes the traffic

across the multiple backend servers by using various methods. The middle component is responsible for distributing the client requests to the server.

Client-Side Load Balancing: The client holds the list of server's IPs so that it can deliver the requests. The client selects an IP from the list, randomly, and forwards the request to the server.

19. Give an example for Spring Cloud Sleuth?

Responsible to maintain the unique id from request start to completion.

The Spring Cloud Sleuth token has the following components:

Application name: The name of the application that is defined in the properties file.
Trace Id: The Sleuth adds the Trace Id. It remains the same in all services for a given request.
Span Id: The Sleuth also adds the Span Id. It remains the same in a unit of work but different for different services for a given request.

- ✓ Add below dependency in pom.xml file

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-sleuth</artifactId>
</dependency>
```

- ✓ Added below method in RestController

```
@RequestMapping("/callhome") public String callHome() {
  LOG.log(Level.INFO, "calling home");
  return restTemplate.getForObject("http://localhost:8080", String.class);
}
```

- ✓ In the logger we can see this after method execution

```
[slueth-sample,44462edc42f2ae73,44462edc42f2ae73,false] 13978 --- [nio-8080-exec-1] com.example.SleuthSampleApplication : calling home
```

- ✓ In the above logger Boolean value indicates whether the span is exported to Zipkin server or not.

20. Which design patterns followed by micro services?

- ✓ API Gateway Pattern
- ✓ Aggregator Pattern

- ✓ Service Discovery Pattern
- ✓ Circuit Breaker Pattern
- ✓ Asynchronous Messaging
- ✓ Chain of Responsibility Pattern
- ✓ Database Pattern

21. Explain about ZuulApiGatewayFilter methods?

ZuulFilter class has four abstract methods that are listed below,

shouldFilter(): The shouldFilter() method checks the request and decides whether filter to be executed or not.
run(): The run() method invokes, if both !isFilterDisabled() and shouldFilter() methods returns true.
filterType(): The filterType() method classify a filter by type.
There are four types of standard filters in Zuul:
pre for pre-routing filtering
route for routing to an origin
post for post-routing filters
error for error handling
Zuul also supports a static type for static responses. Any filter type can be created or added and run by calling the method runFilters(type).
filterOrder(): The filter order must be defined for a filter. Filters may have the same filter order if the precedence is not important for the filters. The filter order does not need to be sequential.

22. Explain about Load Balancing with Zuul?

When Zuul receives a request, it picks up one of the physical locations available and forwards requests to the actual service instance. The whole process of caching the location of the service instances and forwarding the request to the actual location is provided out of the box with no additional configurations needed.

23. Can Zuul Edge Server be used without Eureka / Ribbon?

Yes, it is totally possible by doing the below changes application.yml file of ZuulAPiGateWay application.

```
zuul:
  routes:
    yourService:
      path: /yourService/**
      serviceId: yourService

ribbon:
  eureka:
    enabled: false

yourService:
  ribbon:
    listOfServers: localhost:8080
```

24. What are all the tools you are using for Micro Services In your project?

Kibana: For Logs Monitoring
AppDynamics: For application status monitoring
Eureka Dashboard: For checking the application status and health check

25. In which cases microservice architecture best suited?

Microservice architecture is best suited for desktop, web, mobile devices, Smart TVs, Wearable, etc.

26. How Do You Override a Spring Boot Project's Default Properties?

This can be done by specifying the properties in application.properties.
For example – In Spring MVC applications, you have to specify the suffix and prefix. This can be done by entering the properties mentioned below in application.properties.

For suffix – spring.mvc.view.suffix: .jsp
For prefix – spring.mvc.view.prefix: /WEB-INF/

27. What Do You Mean By End-To-End Testing Of Microservices?

End-to-end testing validates every process in the workflow is functioning correctly. It also ensures that the system works together as a whole and satisfies all requirements.

28. How to improve the Micro Services performance with huge data?

- ✓ Use Async requests with the help of Executive Service if we need to work with multiple micro services.
- ✓ Use the caching technique like Redis Cache.
- ✓ Scale the instances based on the bandwidth.
- ✓ Use the NOSQL databases instead of relational databases.

- ✓ Use the database pool.
- ✓ Cache the frequently used database queries.
- ✓ Use Asynchronous message techniques like Rabbit MQ/Kafka.
- ✓ Batch processing if data to be regularly sync.

29. Explain the Micro Services 12 factor principle?

- ✓ **Codebase:** In Microservices, every service should have its own codebase. Having an independent codebase helps you to easy CI/CD process for your applications.

- ✓ **Dependencies:** It talks about managing the dependencies externally using dependency management tools instead of adding them to your codebase. From the perspective of the java, you can think of Gradle as a dependency manager. You will mention all the dependencies in build.gradle file and your application will download all the mentioned dependencies from maven repository or various other repositories.

- ✓ **Config:** Externalize the configurations from the application. In a microservice service environment, you can manage the configurations for your applications from a source control like Git.

- ✓ **Backing Services:** 12-factor app can automatically swap the application from one provider to another without making any further modifications to the code base. Let us say, you would like to change the database server from MySQL to Aurora. To do so, you should not make any code changes to your application. Only configuration change should be able to take care of it.

- ✓ **Build, release, and Run:** You can use CI/CD tools to automate the builds and deployment process. Docker images make it easy to separate the build, release, and run stages more efficiently.

- ✓ **Processes:** The application should not store the data in in-memory and it must be saved to a store and use from there. As far as the state concern, your application should store the state in the database instead of in memory of the process. By adopting the stateless nature of REST, your services can be horizontally scaled as per the needs with zero impact. If your system still requires to maintain the state use the attached resources (redis, Memcached, or datastore) to store the state instead of in-memory.

- ✓ **Port Binding:** In short, this is all about having your application as a standalone instead of deploying them into any of the external web servers. Spring boot is one example of this one. Spring boot by default comes with embedded tomcat, jetty, or undertow.

- ✓ **Concurrency:** This talks about scaling the application. Twelve-factor app principles suggest to consider running your application as multiple processes/instances instead of running in one large system. You can still opt-in for threads to improve the concurrent handling of the requests.

- ✓ **Disposability:** The system should not get impacted when new instances are added or takedown the existing instances as per need. This is also known as system disposability.

- ✓ **Dev/prod parity:** The twelve-factor methodology suggests keeping the gap between development and production environment as minimal as possible. This reduces the risks of showing up bugs in a specific environment.

- ✓ **Logs:** Logs become paramount in troubleshooting the production issues or understanding the user behavior. Logs provide visibility into the behavior of a running application.

- ✓ **Admin processes:** Ensure one-off scripts are automated so that you don't need to worry about executing them manually before releasing the build.

30. Difference between Horizontal and vertical scaling?

Horizontal scaling: It means that you scale by adding more machines into your pool. Thousands of instances will do the work together for you.

Vertical scaling: It means that you scale by adding more power (CPU, RAM) to an existing machine. One big hulk will do all the work for you.

31. How to do the auto scaling in Micro Services?

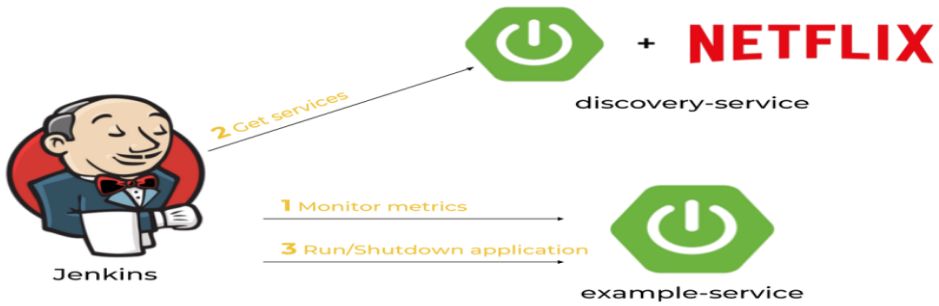
In the PCF we are following the horizontal scaling. Internally it will check the CPU performance metrics based on the metrics it will auto scale or down the instances.

Below is another way of doing the auto scaling.

Every Spring Boot application, which contains the Spring Boot Actuator library can expose metrics under the endpoint **/actuator/metrics**. There are many valuable metrics that gives you the detailed information about an application status. Some of them may be especially important when talking about autoscaling: JVM, CPU metrics, a number of running threads and a number of incoming HTTP requests. There is dedicated Jenkins pipeline responsible for monitoring application's metrics by polling endpoint **/actuator/metrics** periodically. If any monitored metrics is below or above target range it runs new instance or shut down a running instance of the application using another Actuator endpoint, **/actuator/shutdown**. Before that, it needs to

fetch the current list of running instances of a single application in order to get an address of existing application selected for shutting down or the address of the server with the smallest number of running instances for a new instance of application.

Our application needs to meet some requirements: it has to expose metrics and endpoint for graceful shutdown, it needs to register in Eureka after startup and deregister on shutdown, and finally, it also should dynamically allocate running port randomly from the pool of free ports.



32. How to stop a Spring Boot based microservices at startup if it cannot connect to the Config server during bootstrap?

If you want to halt the service when it is not able to locate the config-server during bootstrap, then you need to configure the following property in microservices bootstrap.yml.

```
spring:
      cloud:
         config:
             fail-fast: true
```

Using this configuration will make microservice startup fail with an exception when config-server is not reachable during bootstrap.

33. Explain ACID properties?

- ✓ **Atomicity:** no matter if a transaction has one, two or a hundred of steps; all of them must complete successfully. Otherwise the transaction will be rolled back;

- ✓ **Consistency:** This means that integrity constraints must be maintained so that the database is consistent before and after the transaction. It refers to the correctness of a database. Referring to the example above,

The total amount before and after the transaction must be maintained.
Total before T occurs = 500 + 200 = 700.
Total after T occurs = 400 + 300 = 700.
Therefore, database is consistent. Inconsistency occurs in case T1 completes but T2 fails. As a result T is incomplete.

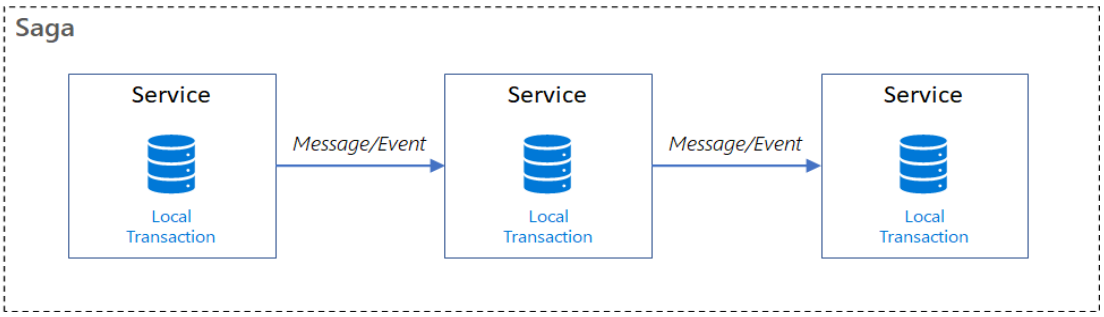
- ✓ **Isolation:** one transaction can't touch the data that is being touched by other transaction in the same time;

- ✓ **Durability:** The effects of an accomplished transaction are permanently recorded in the database and must not get lost or vanished due to subsequent failure. So this becomes the responsibility of the recovery sub-system to ensure durability.

34. What is meant by Saga Pattern?

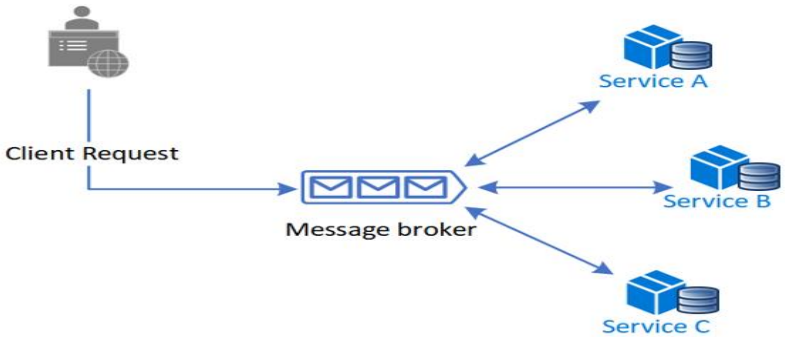
The saga design pattern is a way to manage data consistency across microservices in distributed transaction scenarios. A saga is a sequence of transactions that updates each service and publishes a message or event to trigger the next transaction step. If a step fails, the saga executes compensating transactions that counteract the preceding transactions.

The saga pattern provides transaction management using a sequence of local transactions. A local transaction is the atomic work effort performed by a saga participant. Each local transaction updates the database and publishes a message or event to trigger the next local transaction in the saga. If a local transaction fails, the saga executes a series of compensating transactions that undo the changes that were made by the preceding local transactions.



Types of Saga:

Choreography: Choreography is a way to coordinate sagas where participants exchange events without a centralized point of control. With choreography, each local transaction publishes domain events that trigger local transactions in other services.



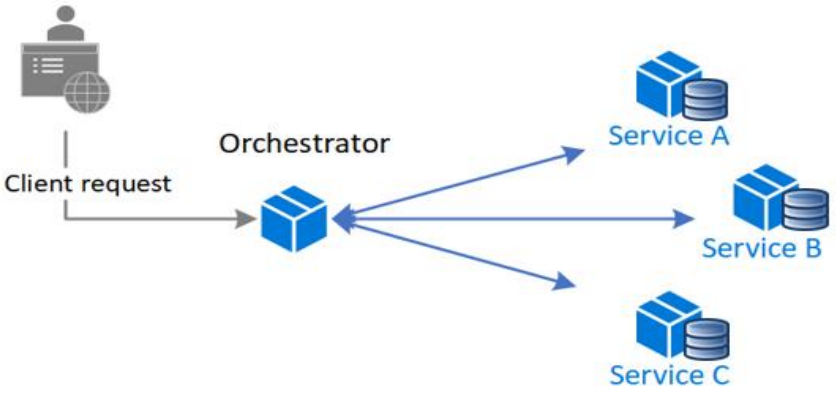
Benefits

- ✓ Good for simple workflows that require few participants and don't need a coordination logic.
- ✓ Doesn't require additional service implementation and maintenance.
- ✓ Doesn't introduce a single point of failure, since the responsibilities are distributed across the saga participants.

Drawbacks

- ✓ Workflow can become confusing when adding new steps, as it's difficult to track which saga participants listen to which commands.
- ✓ There's a risk of cyclic dependency between saga participants because they have to consume each other's commands.
- ✓ Integration testing is difficult because all services must be running to simulate a transaction

Orchestration: Orchestration is a way to coordinate sagas where a centralized controller tells the saga participants what local transactions to execute. The saga orchestrator handles all the transactions and tells the participants which operation to perform based on events. The orchestrator executes saga requests, stores and interprets the states of each task, and handles failure recovery with compensating transactions.



Benefits

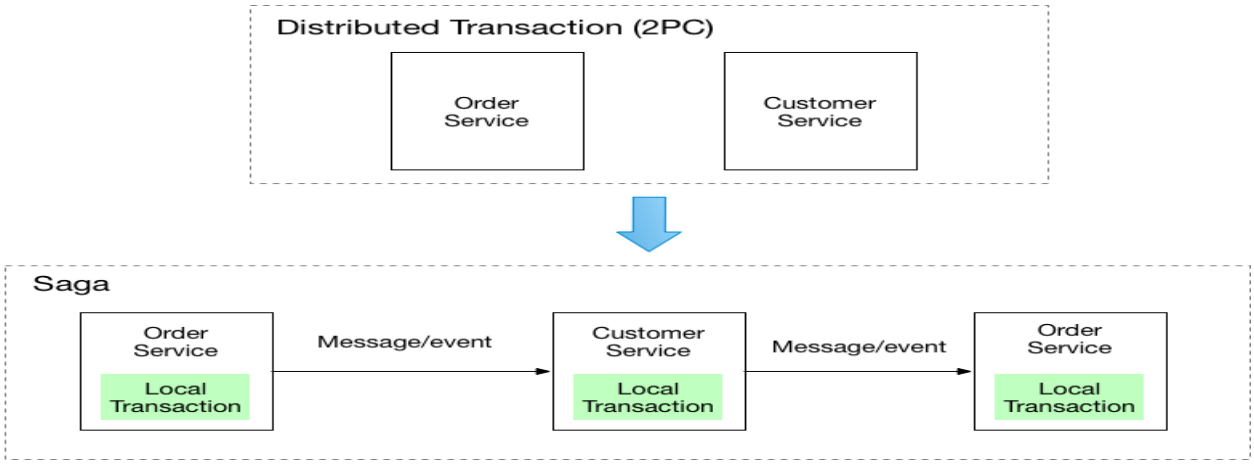
- ✓ Good for complex workflows involving many participants or new participants added over time.
- ✓ Suitable when there is control over every participant in the process, and control over the flow of activities.
- ✓ Doesn't introduce cyclical dependencies, because the orchestrator unilaterally depends on the saga participants.
- ✓ Saga participants don't need to know about commands for other participants. Clear separation of concerns simplifies business logic.

Drawbacks

- ✓ Additional design complexity requires an implementation of a coordination logic.
- ✓ There's an additional point of failure, because the orchestrator manages the complete workflow.

35. How to maintain the data integrity in Micro Services?

You have applied the Database per Service pattern. Each service has its own database. Some business transactions, however, span multiple service so you need a mechanism to implement transactions that span services. For example, let's imagine that you are building an e-commerce store where customers have a credit limit. The application must ensure that a new order will not exceed the customer's credit limit. Since Orders and Customers are in different databases owned by different services the application cannot simply use a local ACID transaction.



Saga Pattern:

Implement each business transaction that spans multiple services is a saga. A saga is a sequence of local transactions. Each local transaction updates the database and publishes a message or event to trigger the next local transaction in the saga. If a local transaction fails because it violates a business rule then

the saga executes a series of compensating transactions that undo the changes that were made by the preceding local transactions.

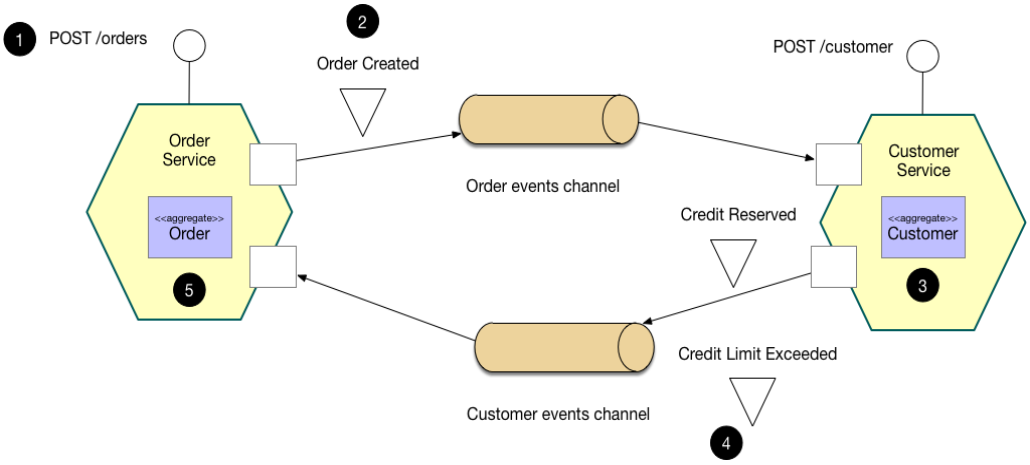
There are two ways of coordination sagas:

- ✓ **Choreography** - each local transaction publishes domain events that trigger local transactions in other services
- ✓ **Orchestration** - an orchestrator (object) tells the participants what local transactions to execute

Example: Choreography-based saga

In the Saga Choreography pattern, each microservices that is part of the transaction publishes an event that is processed by the next microservice. To use this pattern, one needs to make a decision whether the microservice will part of the Saga. Accordingly, the microservice needs to use the appropriate framework to implement Saga. In this pattern, the Saga Execution Coordinator is either embedded within the microservice or cab be a standalone component.

In the Saga, choreography flow is successful if all the microservices complete their local transaction and there is no failure reported by any of the microservice.

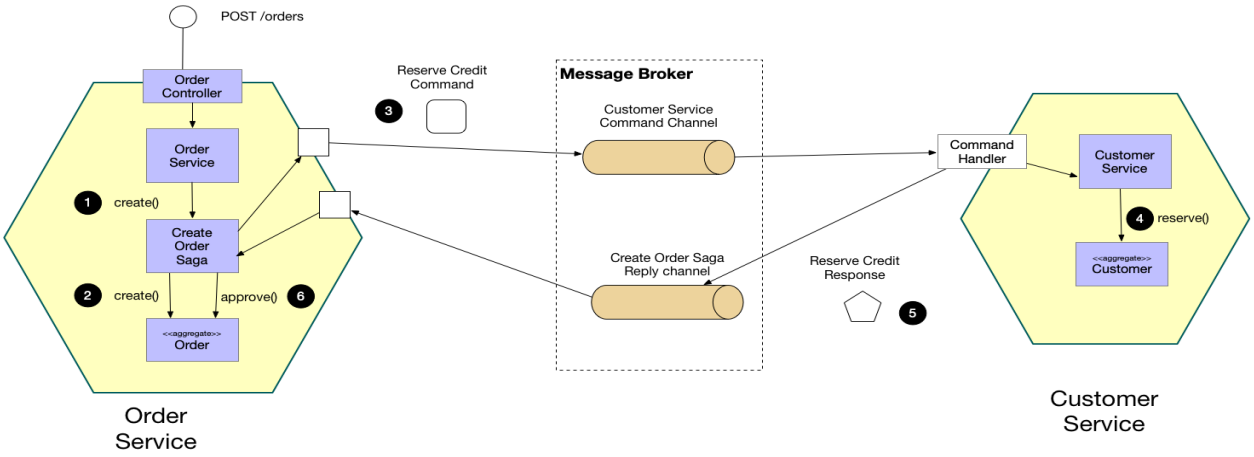


An e-commerce application that uses this approach would create an order using a choreography-based saga that consists of the following steps:

- ✓ The Order Service receives the POST /orders request and creates an Order in a PENDING state
- ✓ It then emits an Order Created event
- ✓ The Customer Service's event handler attempts to reserve credit
- ✓ It then emits an event indicating the outcome
- ✓ The Order Service's event handler either approves or rejects the Order.

Example: Orchestration-based saga

In the Orchestration pattern, a single orchestrator is responsible for managing the overall transaction status. If any of the microservice encounters a failure, then the orchestrator is responsible for invoking the necessary compensating transactions:



An e-commerce application that uses this approach would create an order using an orchestration-based saga that consists of the following steps:

- ✓ The Order Service receives the POST /orders request and creates the Create Order saga orchestrator
- ✓ The saga orchestrator creates an Order in the PENDING state
- ✓ It then sends a Reserve Credit command to the Customer Service
- ✓ The Customer Service attempts to reserve credit
- ✓ It then sends back a reply message indicating the outcome
- ✓ The saga orchestrator either approves or rejects the Order

36. Explain about Rabbit MQ?

RabbitMQ is a message broker: it accepts and forwards messages. You can think about it as a post office: when you put the mail that you want posting in a post box, you can be sure that Mr. or Ms. Mailperson will eventually deliver the mail to your recipient. In this analogy, RabbitMQ is a post box, a post office and a postman.

The major difference between RabbitMQ and the post office is that it doesn't deal with paper, instead it accepts, stores and forwards binary blobs of data – messages.

It has below components:

- ✓ **Producing:** means nothing more than sending. A program that sends messages is a producer.
- ✓ **Queue:** is the name for a post box which lives inside RabbitMQ. Although messages flow through RabbitMQ and your applications, they can only be stored inside a queue. A queue is only bound by the host's memory & disk limits, it's essentially a large message buffer. Many producers can send messages that go to one queue, and many consumers can try to receive data from one queue.
- ✓ **Consuming:** has a similar meaning to receiving. A consumer is a program that mostly waits to receive messages.

Add below dependency,

```
<dependency>
<groupId>org.springframework.boot</groupId>
<artifactId>spring-boot-starter-amqp</artifactId>
</dependency>
```

Specify the below properties in application.properties,

```
spring.rabbitmq.host=localhost
spring.rabbitmq.port=5672
spring.rabbitmq.username=guest
spring.rabbitmq.password=guest
javainuse.rabbitmq.exchange=javainuse.exchange
javainuse.rabbitmq.queue=javainuse.queue
javainuse.rabbitmq.routingkey=javainuse.routingkey
```

You will use **RabbitTemplate** to send messages, and you will register a Receiver with the message listener container to receive messages. The connection factory drives both, letting them connect to the RabbitMQ server

```
@SpringBootApplication
public class MessagingRabbitmqApplication {
  static final String topicExchangeName = "spring-boot-exchange";
  static final String queueName = "spring-boot";

  @Bean
  Queue queue() {
    return new Queue(queueName, false);
  }
  @Bean
  TopicExchange exchange() {
    return new TopicExchange(topicExchangeName);
  }

  @Bean
  Binding binding(Queue queue, TopicExchange exchange) {
    return BindingBuilder.bind(queue).to(exchange).with("foo.bar.#");
  }

  @Bean
  SimpleMessageListenerContainer container(ConnectionFactory connectionFactory,
      MessageListenerAdapter listenerAdapter) {
    SimpleMessageListenerContainer container = new SimpleMessageListenerContainer();
    container.setConnectionFactory(connectionFactory);
    container.setQueueNames(queueName);
    container.setMessageListener(listenerAdapter);
    return container;
  }

  @Bean
  MessageListenerAdapter listenerAdapter(Receiver receiver) {
    return new MessageListenerAdapter(receiver, "receiveMessage");
  }

  public static void main(String[] args) throws InterruptedException {
    SpringApplication.run(MessagingRabbitmqApplication.class, args).close();
  }
```

Spring AMQP requires that the Queue, the TopicExchange, and the Binding be declared as top-level Spring beans in order to be set up properly.

The queue() method creates an AMQP queue. The exchange() method creates a topic exchange. The binding() method binds these two together, defining the behavior that occurs when RabbitTemplate publishes to an exchange.

We need to add the classes for sending and receiving the messages.

Sending Messages:

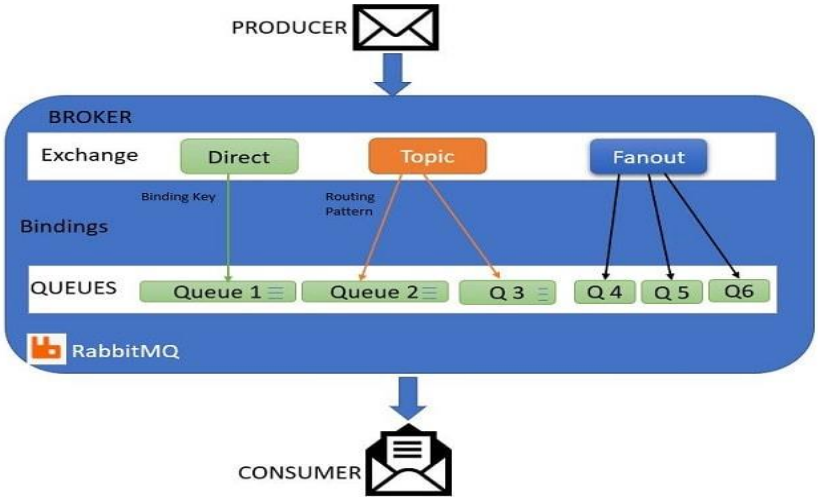
```
@RequestMapping(value = "/javainuse-rabbitmq/")
public class RabbitMQWebController {    @Autowired
    private AmqpTemplate amqpTemplate;    @GetMapping(value = "/producer")
    public String producer(@RequestParam("empName") String empName,@RequestParam("empId") String
empId,@RequestParam("salary") int salary) {
        Employee emp=new Employee();
        emp.setEmpId(empId);
        emp.setEmpName(empName);
        emp.setSalary(salary);        amqpTemplate.convertAndSend("javainuseExchange", "javainuse", emp);
        return "Message sent to the RabbitMQ Successfully";
    }
```

Receiving the Messages:

```
import com.javainuse.model.Employee;@Component
public class RabbitMQConsumer {    private static final Logger logger =
LoggerFactory.getLogger(RabbitMQConsumer.class);    @RabbitListener(queues = "javainuse.queue")
    public void recievedMessage(Employee employee) throws InvalidSalaryException {
        logger.info("Recieved Message From RabbitMQ: " + employee);
        if (employee.getSalary() < 0) {
            throw new InvalidSalaryException();
        }
    }
```

37. Explain Rabbit MQ flow?

- ✓ The producer publishes a message to an exchange. When you create the exchange, you have to specify the type of it. The different types of exchanges are explained in detail later on.
- ✓ The exchange receives the message and is now responsible for the routing of the message. The exchange takes different message attributes into account, such as routing key, depending on the exchange type.
- ✓ Bindings have to be created from the exchange to queues. In this case, we see two bindings to two different queues from the exchange. The Exchange routes the message into the queues depending on message attributes.
- ✓ The messages stay in the queue until they are handled by a consumer
- ✓ The consumer handles the message.



38. What is meant by Exchange?

Messages are not posted directly in the queue; rather, the user sends messages to the exchange. An exchange is responsible for routing the messages to the various queues. An exchange receives messages from the producer request and routes them by bindings and routing keys to message queues. A binding is a linkage between an exchange and a queue.

39. Explain types of Exchanges?

- ✓ **Direct:** Direct exchange transfers messages to queues on the basis of a message routing key. The message is routed in a direct exchange to the queues whose binding key exactly matches the message's routing key. If the queue is bound to the binding key exchange, a message will be sent to the exchange with a routing key to the queue.
- ✓ **Fanout:** A fanout sends messages to all the queues linked to it.
- ✓ **Topic:** The topic exchange matches the wildcard between the routing key and the binding routing pattern.
- ✓ **Headers:** Headers exchanges use the routing attributes of the message header.